5/9-91 ABS. ONLY

N94-35414

p. 2 2959

FLUVIAL PROCESSES IN MA'ADIM VALLIS AND THE POTENTIAL OF GUSEV CRATER AS A HIGH PRIORITY SITE;

Nathalie Cabrol[1], Ragnild Landheim[2], Ronald Greeley[3], and Jack Farmer[4]. [1] *Observatoire de Meudon,* [2] *Department of Botany and Geology, Arizona State University, Tempe, AZ,* [3] *Department of Geology, Tempe, AZ,* [4] *NASA Ames Research Center, Moffet Fiels, CA.*

Introduction

According to exobiology site selection criteria for Mars (Farmer et al., 1993), the search for potential extinct/ extant water dependant life should focus on sites were water flowed and ponded. The Ma'adim Vallis/Gusev crater system is of high priority for exobiology research, because it appears to have involved long-term flooding, different periods and rates of sedimentation (Schneeberger, 1989), and probable episodic ponding.

Evidence for non-uniform fluvial processes

Ma'adim Vallis exibits a series of elevated terraces which lie above the present valley floor (Landheim et al., 1994). The length of the valley, the lateral continuity of the terraces and thickness of terrace deposits suggest that the region experienced long-term, non uniform processes of fluvial erosion and deposition, reflected in geomorphic features along the valley floor, at the valley mouth, and within Gusev crater. Along the downstream course of Ma'adim Vallis at least ten different levels of terraces are visible along the west bank of the valley, and at least eleven on the east bank. These terraces represent a minimum estimate that is likely to increase as higher resolution images become available.

Three levels of terraces are visible within the two 30 km diameter impact craters located at the mouth of Ma'adim Vallis (Landheim et al., 1994). Three terraces (T9-T11) which occur within Gusev crater are interpreted to represent fluvial deposits that are correlated by elevation to fluvial terraces in Ma'adim Vallis. Other levels recognized within Gusev crater are not found in the valley system, but could be associated with upper terraces on the surrounding plateau which are related to small valley networks adjoining Gusev crater on the SW and SE rims. The suggested terrace correlations provide a framework linking the morphology and stratigraphy of deposits within Gusev crater to processes operating within the downstream region of the Ma'adim Vallis.

Early overflooding of the plateau and ponding

Table 1 summarizes our interpretation of the evolution of terracing within the lower 40 km of Ma'adim Vallis. In the early stages represented, the channel floor of Ma'adim Vallis appears to have been about 900 m above the current level. Remnants of five upper terraces (T1-T5) are visible on the plateau. They terminate along the southern margins and continue on the C1 west bank and C3 east bank where they adjoin small fluvial valleys entering Gusev crater. These observations suggest the three large imapct craters located at the outlet formed natural dam to flow from Ma'adim Vallis, and that water ponded locally to form a lake which backed up into the lower part iof the valley (Cabrol et al., 1993$_a$, 1993$_b$).

The slight sinuosity of terraces T1 to T5 reflects original channel meandering. The terraces also appear to correspond to channelization of the flow by small valley networks on the SW and SE rims of Gusev crater, leading to the setting of two different levels of sedimentation inside the crater, which may be evidence of a crater-lake that overtopped the Gusev north rim. The overtopping generated a catastrophic release of water to the northern plains. This period left less than 200 m thick deposits distributed into five sequences of comparable ampmlitude (Table 1). The correlative sequences of erosion were observed by the deepening of the valley section, which at T5 is located about 200 m below the primary level, and by its reduction in width.

From terrace level T6, the flow changed direction to enter its present axis. This episod is interpreted to correspond to the opening of the southern rims of C1 and C3 impact craters and to the sedimentation inside these basins, with drainage of the remnant flood plain towards Ma'adim Vallis through small valley networks that are visible on both banks. Because the T6 level is not observed inside Gusev crater, the northern rim of C3 is interpreted to have acted as a dam. The visible thickness of the deposits inside C1 and C3 (Table 1) are twice that observed for previous episodes, suggesting that the increase in erosion was linked to a drop in base level. This event appears to have lowered the channel floor at least 70 m to a level corresponding to that of C1/C3 floor.

After T9, all the terrace levels in Ma'adim Vallis correspond to deposits found in Gusev crater, as described in Landheim et al., (1994). Breaching of the last northern rim of C3 is believed to represent a base level drop of at least 500 meters and appears to correlate to accelerated channel incision into the T9 terrace deposits within Ma'adim Vallis. The depth achieved by this incision event was equivalent to the difference in elevation between Gusev crater and the thickness of the T9 deposits.

The geomorphology of the deposits within Gusev crater provide evidence for loaded flows, especially the shape and thickness of the delta remnants, and the different lobes of sedimentary deposits fronts

FLUVIAL PROCESSES IN MA'ADIM VALLIS; Cabrol, N.A et al.,

within Gusev crater.

Conclusion

During its period of fluvial activity, Ma'adim Vallis experienced different fluvial processes, from slow sedimentation rates to catastrophic release of mud-like flows. The results was accumulation of nearly 900 meters of fluvial sediments which were derived from different source rocks upstream in the region. This exceptional diversity designates Ma'adim vallis-Gusev crater system high priority for exobiology studies.

Table 1 :

	Terrace n°	Elev.(km)	Width (km)[1]	Volume of sediments
Young	11	floor	2	?
	10	0,04	4,4	0,19
	9	0,5	7,5	3,75
	8	0,03	10	0,3
	7	0,05	13,5	0,6
	6	0,07	19	1,3
	5	0,03	21	0,6
	4	0,06	30	1,5
	3	0,04	33,5	1,3
	2	0,03	47,5	1,4
Old	1	0,04	55	2,2

1-Width considers the distance between the terraces of the same level. The volume of sediments is estimated from this width, the 40 km long sample of the valley, and the elevation of the terraces.

References : Cabrol et al., *LPSC XXIV*, 241-242 (1993a); Cabrol et al., (*submitted to Icarus*) (1993b); Landheim et al., *LPSC XXV* , (1994); Farmer et al., *Proceedings of the World Space Conference, 29th meeting of the World Space Congress (COSPAR)* (in press); Schneeberger, *LPSC XX*, 964-965, (1989).

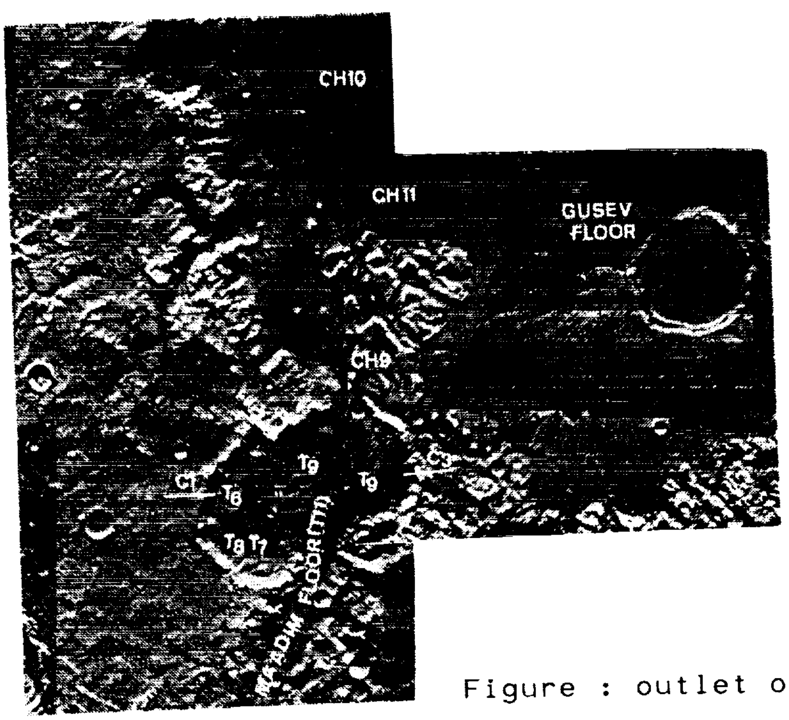

Figure : outlet of Ma'adim Vallis